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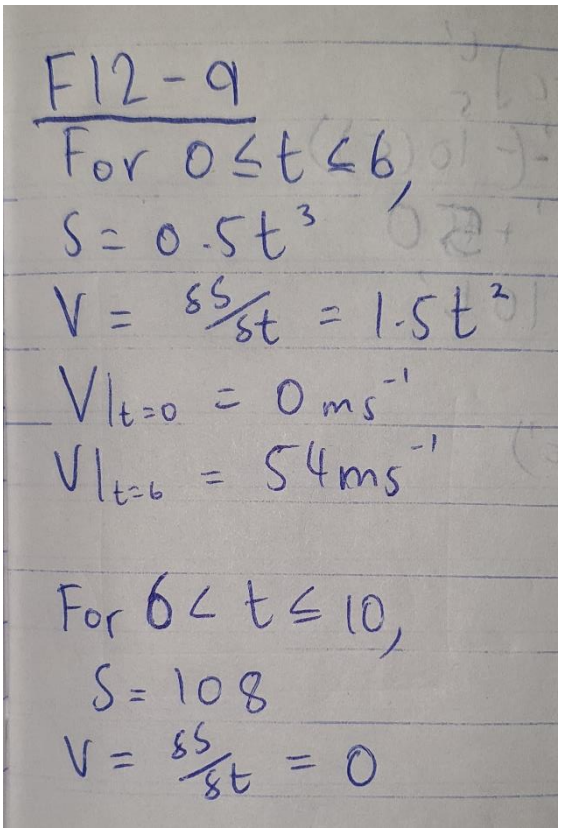
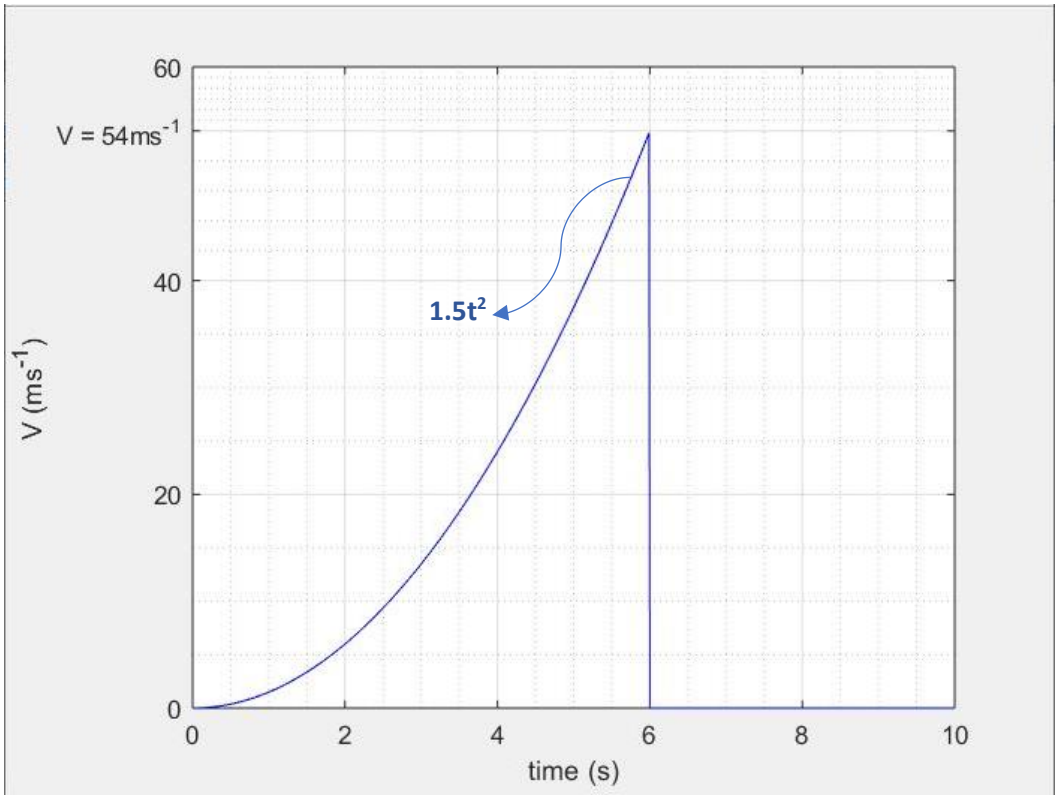
MATRIC Nº: 18/ENG05/056

DEPARTMENT: Mechatronics Engineering

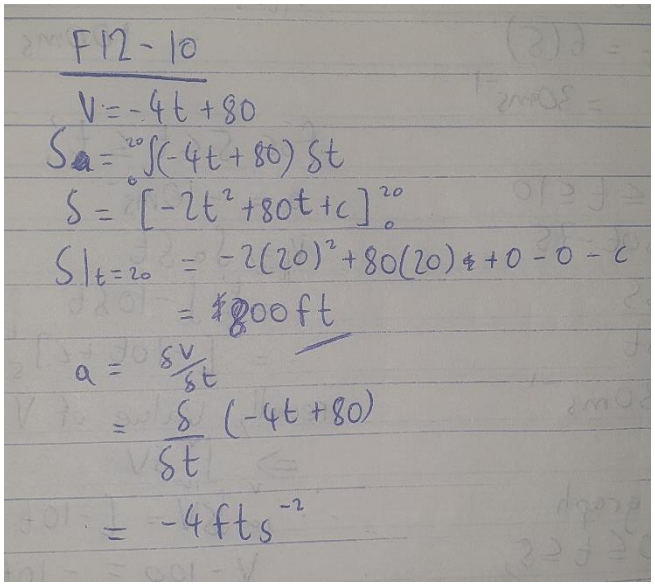
COURSE: ENG 234
(Erratic Motion Assignment)

F12-9

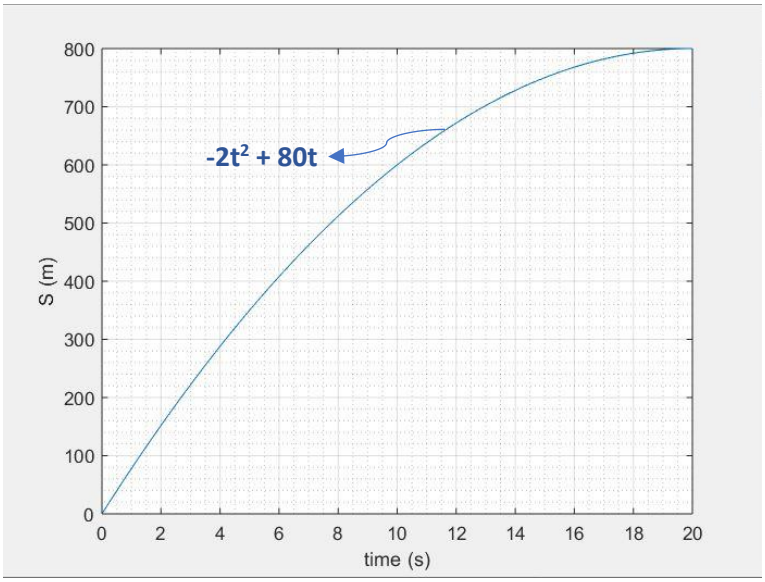

F12-9
For $0 \le t \le 6$,
$S = 0.5t^3$
$V = \delta S/\delta t = 1.5t^2$
$V|_{t=0} = 0\ ms^{-1}$
$V|_{t=6} = 54 ms^{-1}$
For $6 < t \le 10$,
$S = 108$
$V = \delta S/\delta t = 0$


60
V = 54ms-1
40
20
0
V (ms-1)
1.5t2
0
2
4
6
8
10
time (s)

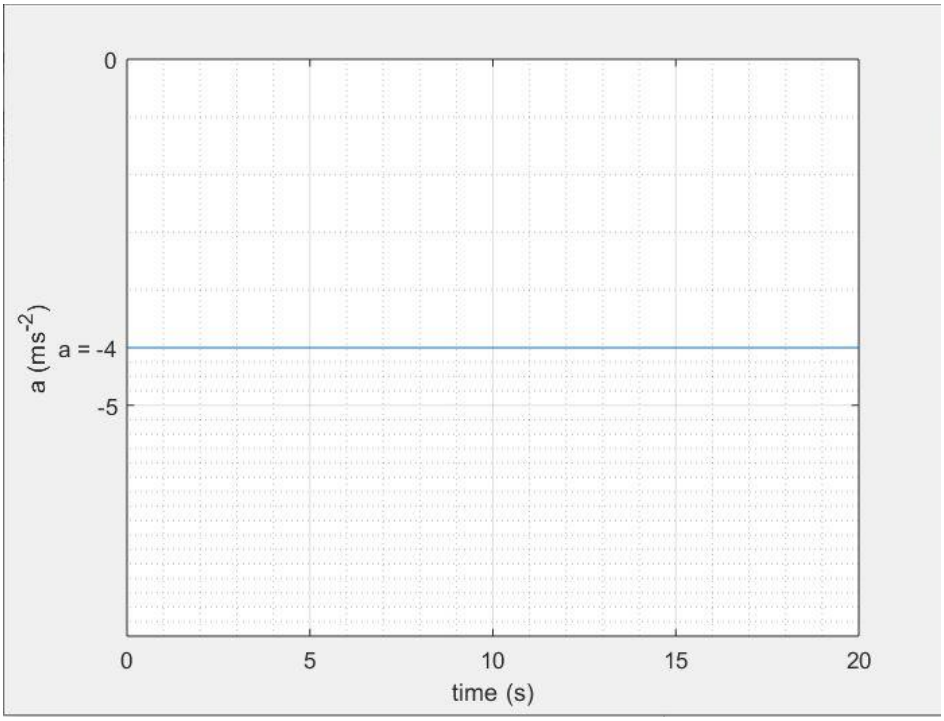
F12-10



S-t Graph



a-t Graph



F12-11

F12-11

$V = 0.25 \cdot S$

Recall, $V \delta V = a \delta S$

$\therefore a = V \frac{\delta V}{\delta S}$

$= 0.25 \cdot S \left[\frac{\delta}{\delta S} (0.25 \cdot S) \right]$

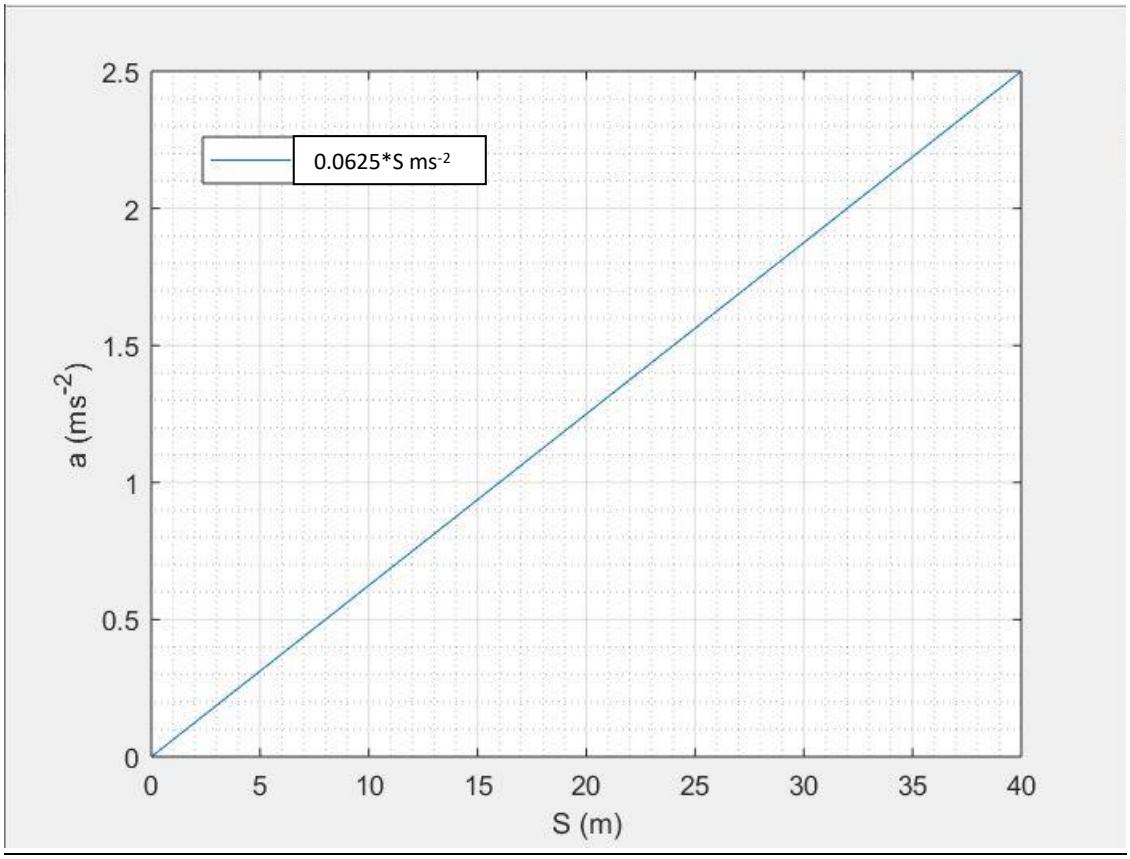
$= 0.25 \cdot S (0.25)$

$= 0.0625 S$

at $t = 0$; $a = 0 ms^{-2}$

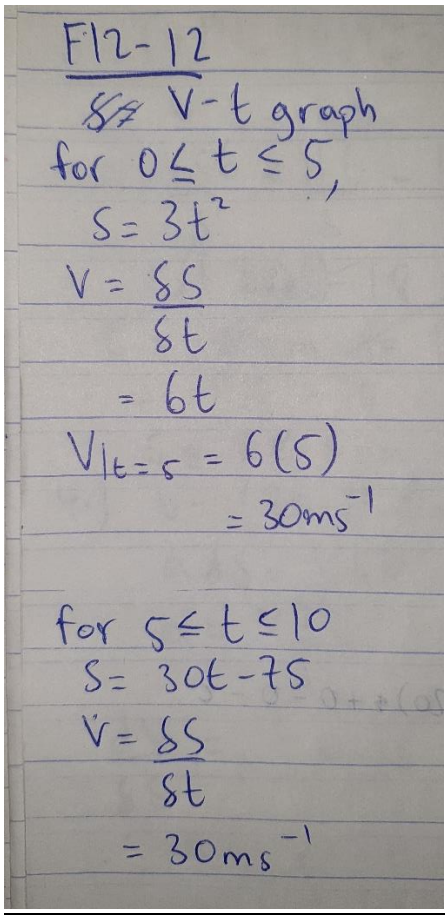
at $t = 40$; $a = 0.0625(40)$

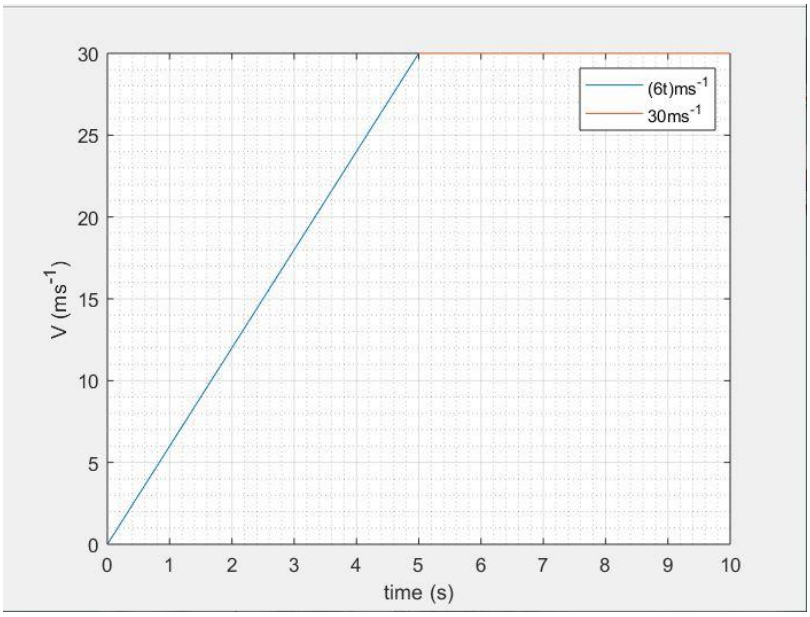
$= 2.5 ms^{-2}$



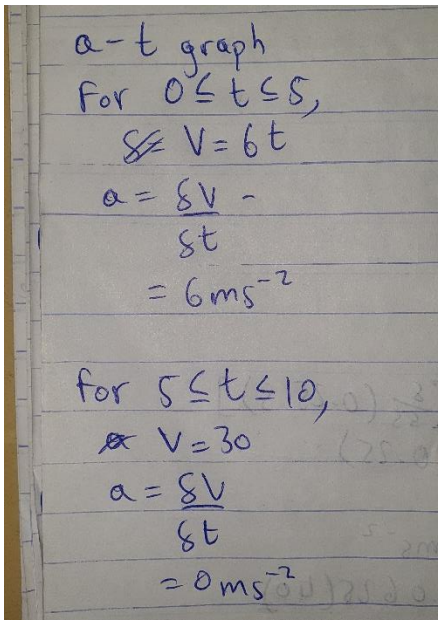
F12-12

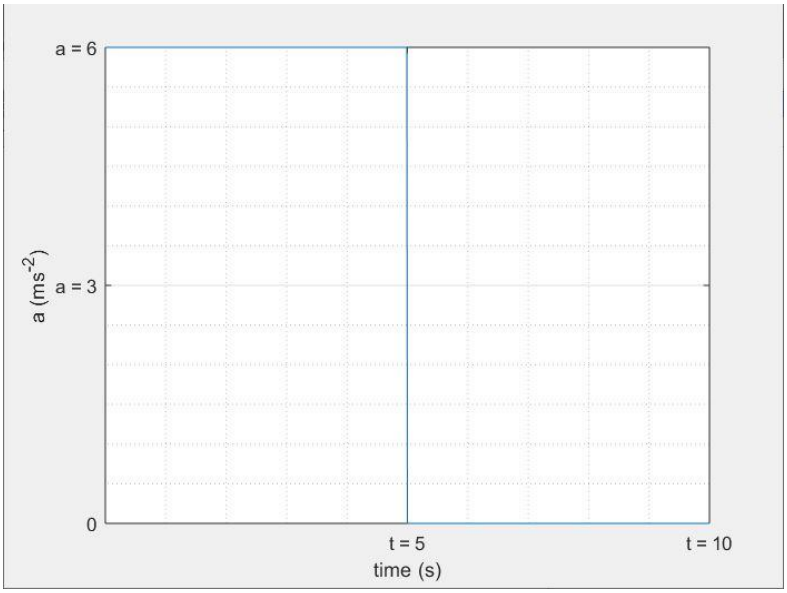
V-t Graph



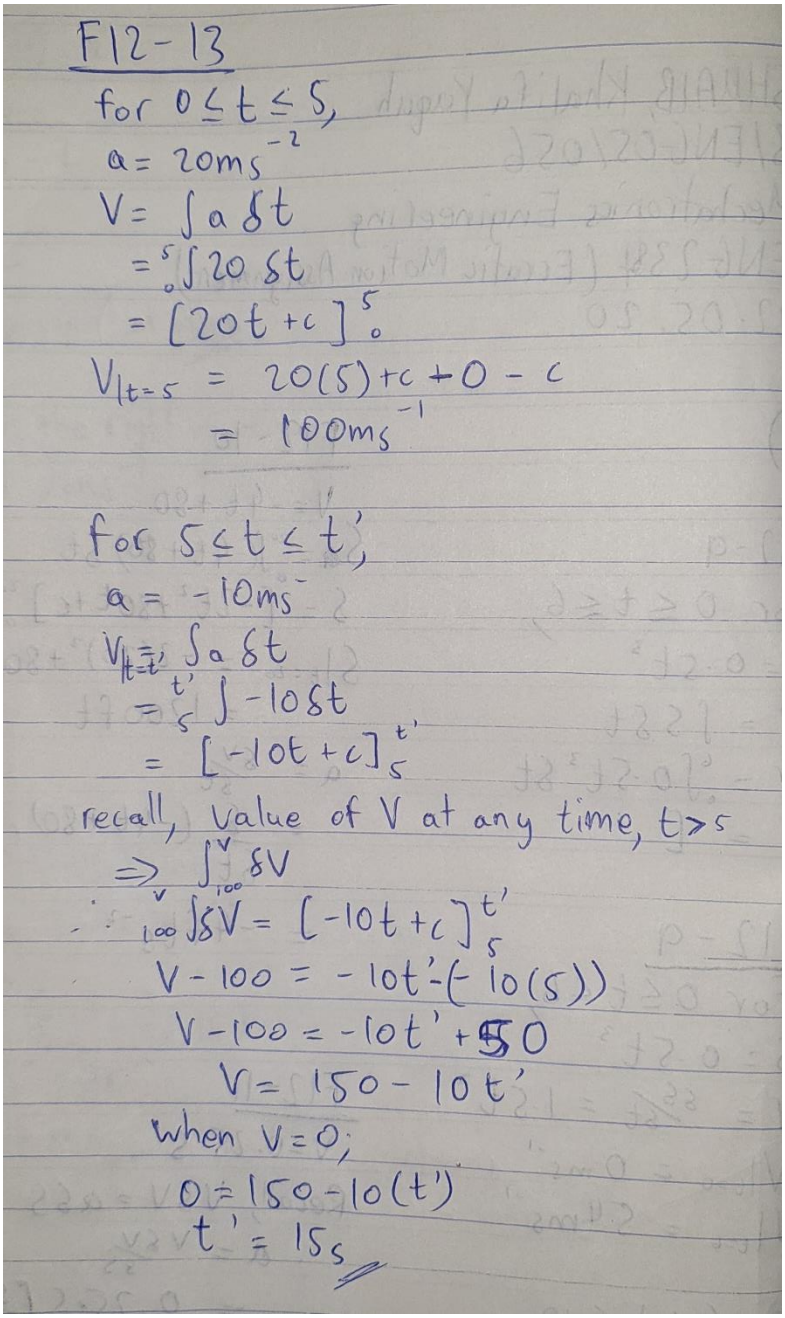


a-t Graph





F12-13



F12-13

for $0 \le t \le 5$,

$a = 20 ms^{-2}$

$V = \int a \, \delta t$

$= \int_0^5 20 \, \delta t$

$= [20t + c]_0^5$

$V_{|t=5} = 20(5) + c + 0 - c$

$= 100 ms^{-1}$

for $5 \le t \le t'$,

$a = -10 ms^{-}$

$V_{|t=t'} = \int a \, \delta t$

$= \int_5^{t'} -10 \, \delta t$

$= [-10t + c]_5^{t'}$

recall, value of V at any time, $t > 5$

$\Rightarrow \int_{100}^{V} \delta V$

$\therefore \int_{100}^{V} \delta V = [-10t + c]_5^{t'}$

$V - 100 = -10t' - (-10(5))$

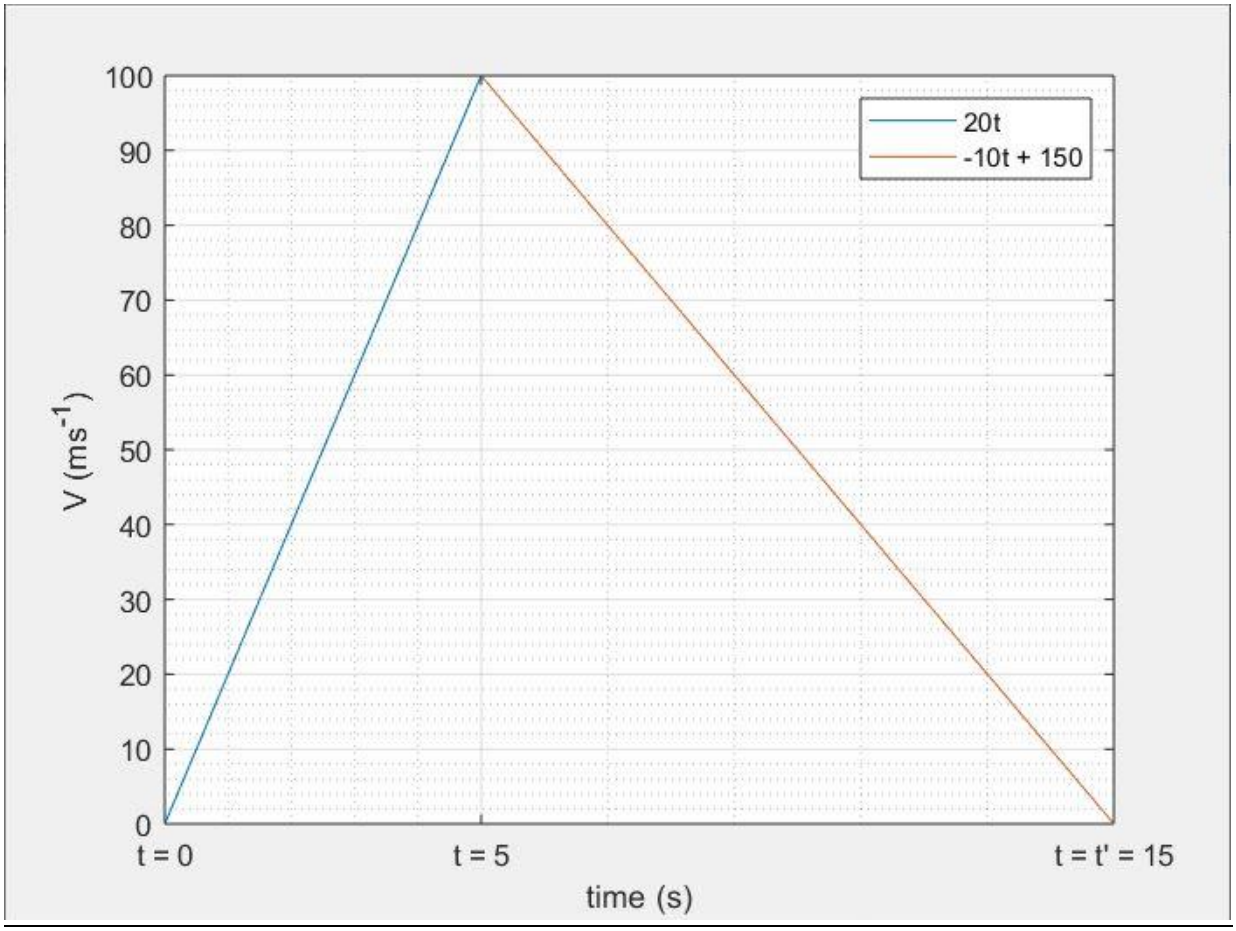
$V - 100 = -10t' + 50$

$V = 150 - 10t'$

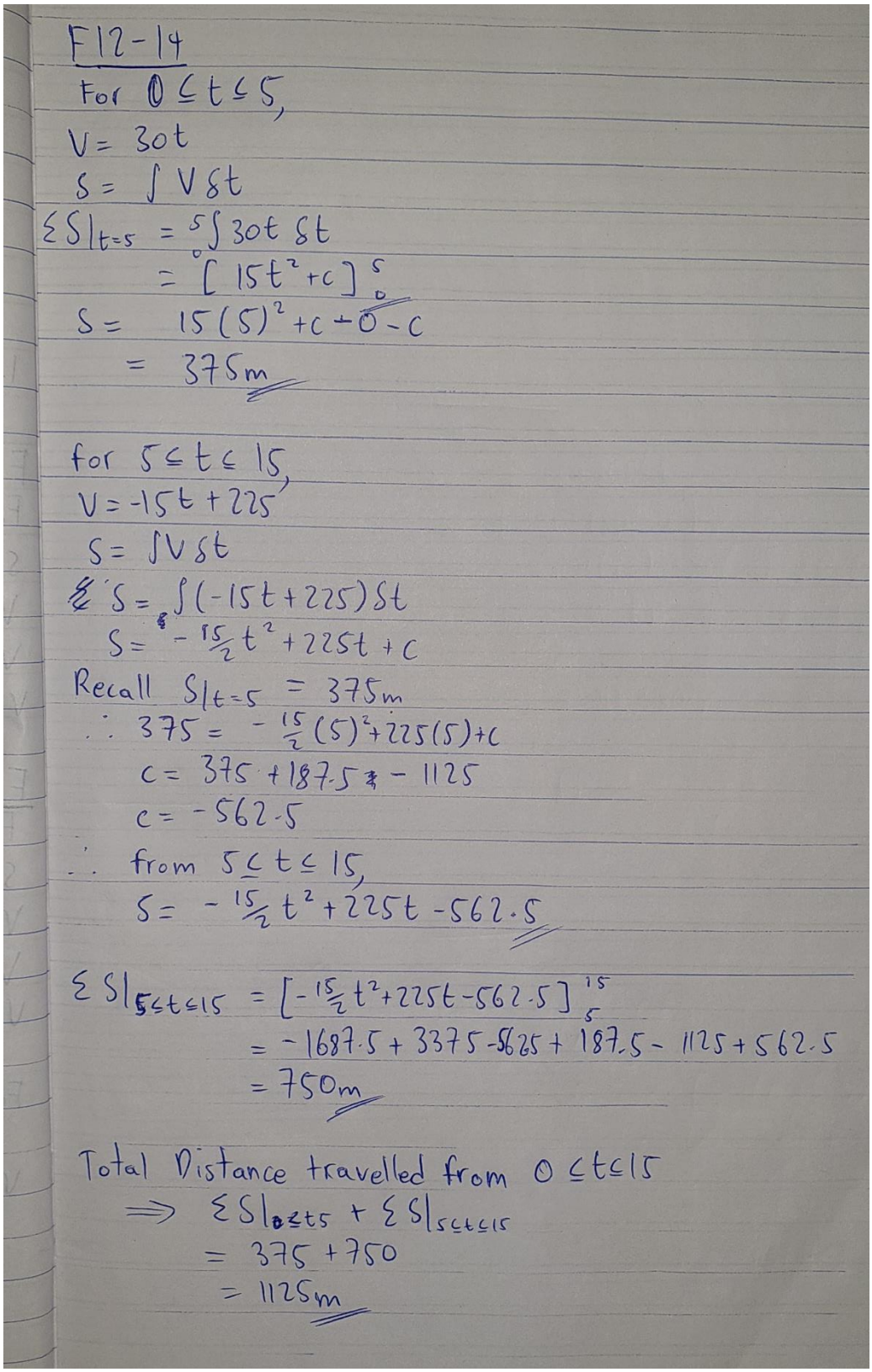
when $V = 0$;

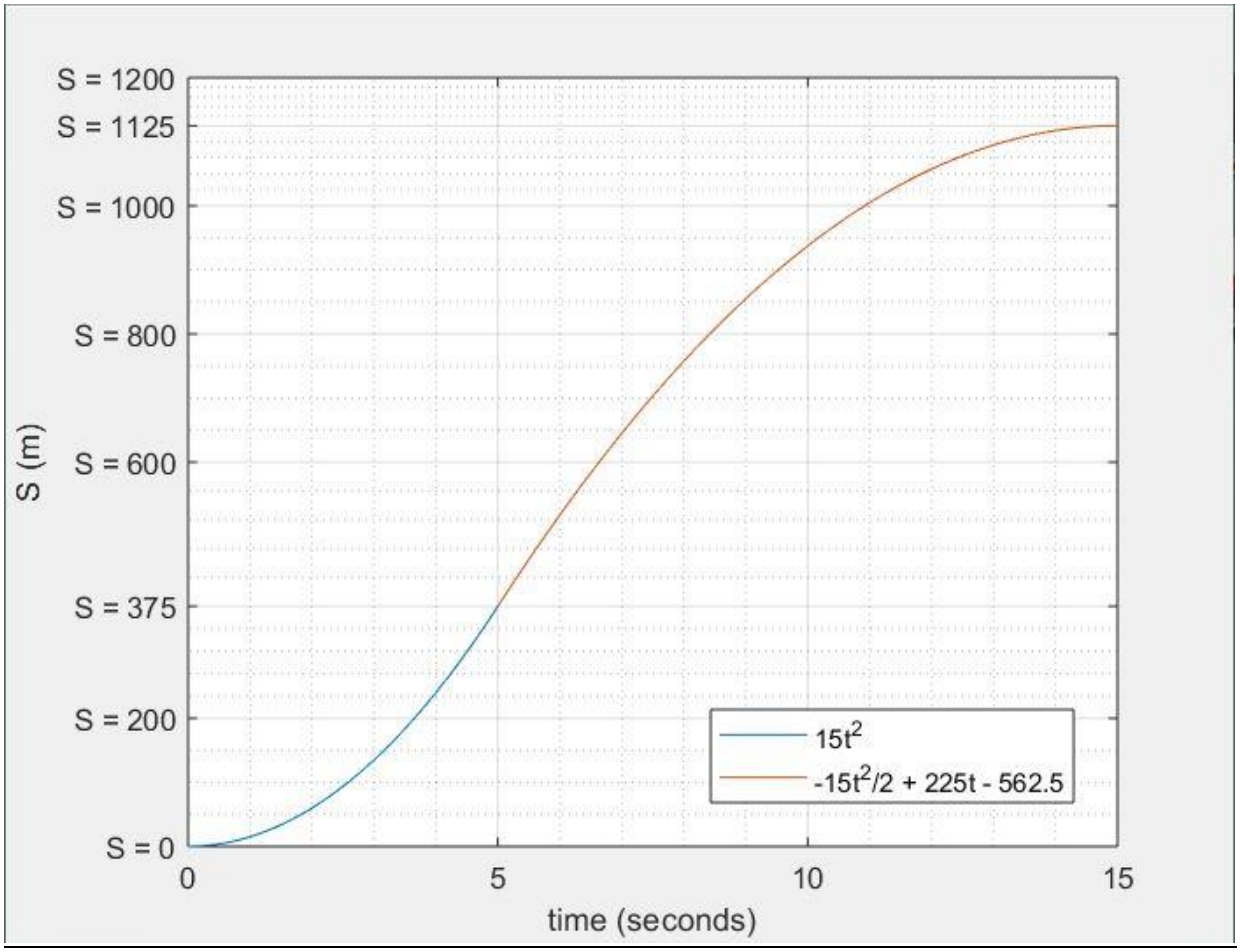
$0 = 150 - 10(t')$

$t' = 15 s$


100
90
80
70
60
50
40
30
20
10
0
V (ms-1)
20t
-10t + 150
t = 0
t = 5
t = t' = 15
time (s)

F12-14


F12-14
For $0 \le t \le 5$,
$V = 30t$
$S = \int V \, \delta t$
$\Sigma S|_{t=5} = \int_0^5 30t \, \delta t$
$= [15t^2 + c]_0^5$
$S = 15(5)^2 + c + 0 - c$
$= 375\text{m}$
for $5 \le t \le 15$,
$V = -15t + 225$
$S = \int V \, \delta t$
$S = \int (-15t + 225) \, \delta t$
$S = -\frac{15}{2}t^2 + 225t + c$
Recall $S|_{t=5} = 375\text{m}$
$\therefore 375 = -\frac{15}{2}(5)^2 + 225(5) + c$
$c = 375 + 187.5 - 1125$
$c = -562.5$
$\therefore$ from $5 \le t \le 15$,
$S = -\frac{15}{2}t^2 + 225t - 562.5$
$\Sigma S|_{5 \le t \le 15} = [-\frac{15}{2}t^2 + 225t - 562.5]_5^{15}$
$= -1687.5 + 3375 - 5625 + 187.5 - 1125 + 562.5$
$= 750\text{m}$
Total Distance travelled from $0 \le t \le 15$
$\Rightarrow \Sigma S|_{0 \le t \le 5} + \Sigma S|_{5 \le t \le 15}$
$= 375 + 750$
$= 1125\text{m}$


S = 1200
S = 1125
S = 1000
S = 800
S = 600
S = 375
S = 200
S = 0
S (m)
0
5
10
15
time (seconds)
15t^2
-15t^2/2 + 225t - 562.5